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Hybrid Wavelet Based CBIR System using Software as a Service (SaaS) Model on public Cloud

Mamta Meena[a], Vinayak A. Bharadi[b], Krunali vartak[c]

[a]*PhD Scholar, Shri Jagdishprasad Jharmal Tibrewala University, jhunjhunu 333001*
[b,c]*Associate Professor, Thakur College of Engineering & Technology, Kandivali (E),Mumbai-400101*

Abstract

CBIR system is widely used for various commercial and official purposes, where image comparison is required, to fulfill business requirements like geographical information, medical diagnosis, security, authenticity, etc. The main functionality of the CBIR application, in which the image is inserted as query, is to extract the visual property of image and save it for future comparison. The problem involved with the standalone architecture is that the system has to perform multiple operations of feature vector extraction, enrollment and verification. Also any failure occur at any point may cause the whole system down. With the increase in the number of users for such application, we need a scalable solution for such application so the system can be modified based on the user requirements. In this paper, we are going to propose a highly scalable, pluggable and faster cloud based CBIR system, which is capable to store, process and extract and operate large number of images. System can be scalable based on the storage and processing requirements

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Keywords: CBIR; Cloud Computing; Wavelets; Cloud Services.

1. Introduction

1.1 Content Based Image Retrieval (CBIR)

Major challenge of today's system is to retrieval information from the large number of database. Content Based Image Retrieval [1] is a very famous technique used to retrieve digitally similar images (fig 1), based on their content, from the large database. Content can be any information about the image that describes the properties of it like color, texture, and shapes. [2, 3, 4].

- Color Based Retrieval: Color histogram is a most popular technique used for the retrieval of images from

* Corresponding author. *E-mail address* mamtameena85@gmail.com

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the large database. In this system, color histogram of each image will be calculated, which represents the proportion of pixel of each color within the image, and then stored in the database. CBIR algorithm, based on the color histogram retrieval, will extract those images from the databases which match with the input image to the system.

- Texture Based Retrieval: Another very important characteristic of an image is texture. Based on texture application will be able to distinguish two images with same color and shape. A large number of techniques are available in market to match the similarities based on texture [5].
- Shape Based Retrieval: In this technique we refer to the well define shapes of the images. Based on the shape we can naturally distinguish the images.

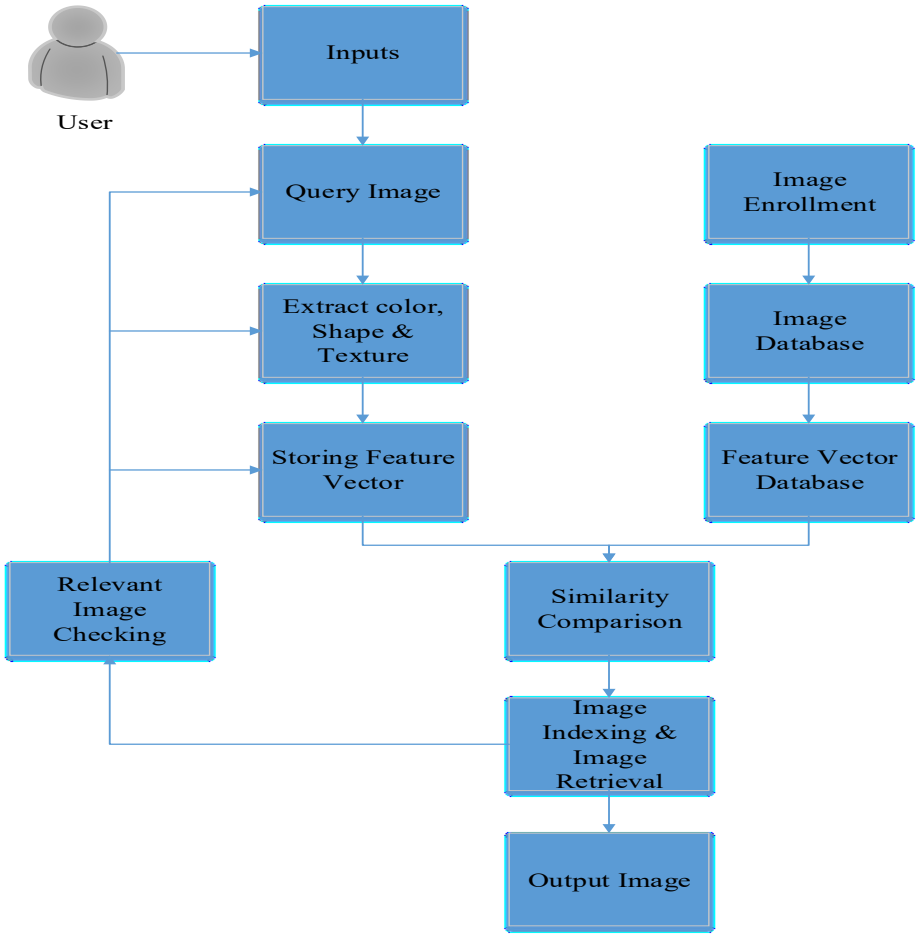


Fig 1. Content Based Image Retrieval Architecture

1.2 Cloud Computing

Cloud computing is another powerful concept in computer world based on the principal of on-demand computing. It is kind of internet based computing which allows user to utilize computing resources from shared pool. It's an economical solution for enterprises with various capabilities like storing their data and processes it at the third party data centers. Using solution provided by cloud any organization can fulfill their needs of infrastructure, platform and application .

- IaaS: Infrastructure-as-a-Service is used to start, stop, access and configure their virtual servers and storage.
- PaaS: Platform-as-a-Service in the cloud is defined as a set of software and product development tools hosted on the provider's infrastructure.

• SaaS: Software-as-a-Service cloud model, the vendor supplies the hardware infrastructure, the software product and interacts with the user through a front-end portal.

1.3 Wavelets

Wavelet transforms [6] plays an important role in image processing, analysis and compression part. Nowadays the wavelet algorithms are very popular and active methods in image processing, de-noising and compression. Since, wavelet allow both time and frequency analysis simultaneously for image compression & Extraction. This paper provides a result of some improved algorithms on the wavelet transform (fig 2).

2. Review of Literature Survey

2.1 Cloud Based CBIR Software as a Service

Images are the effective way of communication. As image data is increasing day by day, we need effective and efficient way to store & retrieve images. CBIR is the technique which works on the principle of feature vector extraction. Feature vector includes color, size, shape, texture, etc. various properties of the images. Implementation of CBIR system on cloud as SaaS services makes it scalable, flexible and much more efficient system [7].

2.2 Online Signature Recognition Using Software as a Service (SaaS) Model on Public Cloud

Another application of CBIR system is to be used for signature recognition. Security and authentication is the backbone for any organization and CBIR can be used for this purpose in commercial and official transactions. The existing system is standalone and not give required performance with the increase in size of database. Implementation of CBIR system on cloud provide faster and efficient solution for this problem. Also it provide sufficient storage as well as high processing power [8].

2.3 NIR: Content Based Image Retrieval on Cloud Computing

In 2009, Zhuo YANG, Sei-ichiro KAMATA and Alireza AHRARY has been proposed an open source cloud based system for image retrieval called NIR. Image retrieval from the large database in an efficient way is the major challenge as the number of users are keep increasing so as data. CBIR is one emerging technologies to deal with it, as it retrieve the images, based on the data, computed from the image itself. NIR is a cloud based CBIR system, so it easily scalable based requirements and flexible to deploy. Also as an open source, it can be easily integrated with any of the existing system [9].

2.4 Content-based Image Retrieval (CBIR) using Hybrid Technique

In 2013 , Zainab Ibrahim Abood , Israa Jameel Muhsin , and Nabeel Jameel Tawfiq researched the another hybrid technique of CBIR using four feature extraction instead of one. The four techniques used are colored histogram features technique, properties features technique, gray level co-occurrence matrix (GLCM) statistical features technique and hybrid technique. These features are extracted from the stored database images as well as user query image for comparison. Three parameter used to measure similarity are normalized Mahalanobis distance, Euclidean distance and Manhattan distance. Hybrid technique gave better result in research as compare to normal CBIR technique [10].

2.5 Content Based Image Retrieval Using Fusion of Gabor Magnitude and Modified Block Truncation Coding

Another CBIR technique proposed by Dr. H B Kekre, V A. Bharadi which use Fusion of Gabor Magnitude and Modified Block Truncation Coding. This technique is worked really well in terms of image texture. It capture energy of image at specific frequency & direction and save the description for comparison. The proposed system was giving higher Precision and Recall as compared to only Gabor and only MBTC based CBIR [11].

2.6 Efficient Relevance Feedback for Content-Based Image Retrieval by Mining User Navigation Patterns

Another technique which uses data-mining concept has been proposed by Ja-Hwung Su, Wei-Jyun Huang, Philip S. Yu and Vincent S. Tseng in 2011. It uses Navigation-Pattern-based Relevance Feedback (NPRF), to achieve the high efficiency and effectiveness of CBIR. Based on the iteration, images are copied and retrieved from the system as per feedback patterns [12].

3. Implementation

3.1 Methodology for CBIR

In this paper, we proposed the Cloud system which is used to upload images, store the feature vector values and then extract the features of a query image and after that compare that query image to the database images. The features of images are color, texture and shape of the image [13]. So, by using color, texture and shape features of one image we can do matching of image and comparison of images easily. This comparison is performed by distance metrics using color, texture and shape features. The proposed model is capable of working on large amount of images, which, we need for large & sufficient storage capacity and significant processing power.

Step I: Collection of Image Database

• We consider a database containing 100 images with .jpg.

• The images will be from RGB color model.

Step II: Hybrid Wavelet Transform Creation

The Proposed method uses the concept of generating hybrid wavelet (fig 3 & fig 4) transform for extraction from two different transforms [14]. Feature Extraction is carried out by using colors, using textures or by using shapes. The images are registered with their corresponding features such as color, texture, shape. Here Kekre Transform is used to represent the global properties of an image. DCT, Walsh, Haar, Hartley transforms are used one by one to represent local properties of an image. Pairing these transforms with Kekre transform gives following hybrid transforms: Kekre-Walsh, Kekre-DCT, Kekre-Hartley and Kekre-Haar. An idea behind use of hybrid wavelet transform [15] is to explore the good properties of two different transforms by combining them into hybrid wavelet transform (fig 2).

1. Consider Input color image of size 256x256.
2. Separate R, G, B components of an image
3. Let “W1” is Kekre transform of size MxM and “W2” is Walsh of size NxN, then hybrid transform of MNxMN size is generated which is 256x256.
4. Different combinations of “M” and “N” used. Hybrid Wavelet Transform matrix “MNxMN” of size 256x256 is generated.
5. Reconstruct the image by applying inverse transform.
6. A set of twelve different color images is used for experimental work. Each colour image is of size 256x256. Experiments are performed using Visual Studio (fig 5).
7. Hybrid transform is applied on each image and Average of root mean square error between original image and image reconstructed is calculated.

Step III: Feature Vector Evaluation

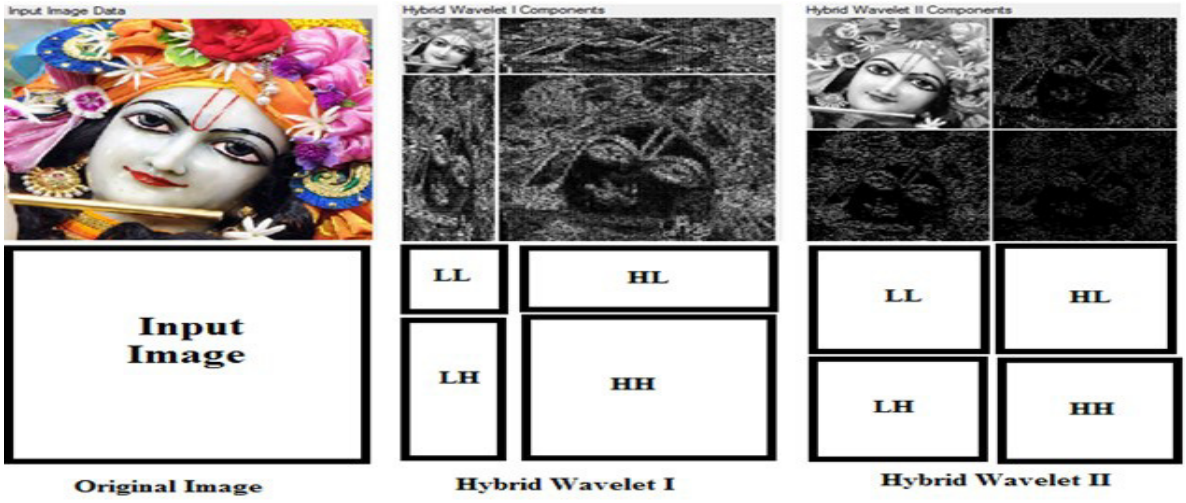


Fig 2. Hybrid Wavelet Architecture

After the images are registered with their corresponding features such as color, texture, shape. These extracted features will be forwarded to Feature Vector Module. Then Similarity measures will be count by using Euclidian

distance. The Direct Euclidian Distance between an image P and query image Q can be given as the equation below ED= ∑ (Vpi -Vqi). (Vpi -Vqi). Where, Vpi and Vqi be the feature vectors of image P and Query image Q respectively with size ‘n’. When the user passes a query image, the composite feature vector of both query image and the image which is stored in database will go through Similarity Comparison.

Step IV: Enrollment of Images are Done

Step V: Finally the image will be retrieved

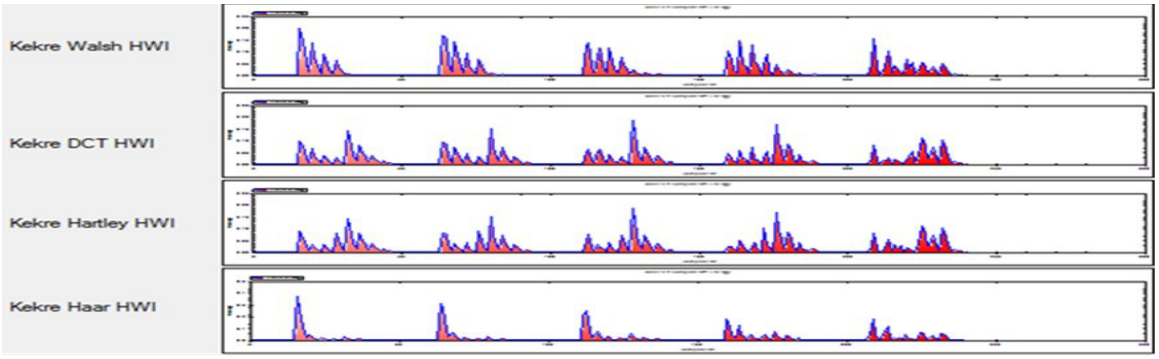


Fig 3. Hybrid Wavelet I

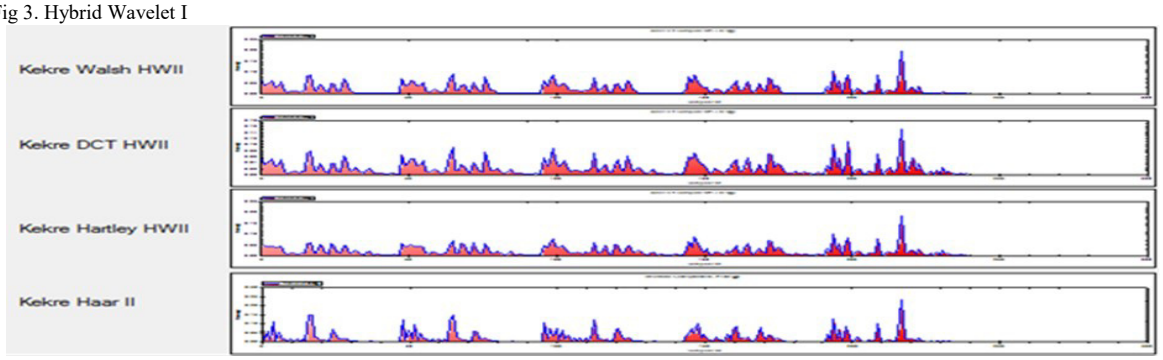


Fig 4. Hybrid Wavelet II

3.2 Proposed technique for Cloud Implementation

3.2.1 Image Uploading Operation

At this stage, images has been uploaded in the database, feature vector of these images has been uploaded in the blob and table storage on the cloud, on the web role, using a web services. System indexed all the image at the stage of uploading itself. In background processes are running to extract the feature vector of images and store it on blob storage. Hybrid wavelet type1 and type2 are going to be used for this purpose.

The uploading operation consists of the following steps shown in figure (6):

1. Images will be uploaded by user using web service running on Web role.
2. Web role will compute feature vector of image using Hybrid Wavelet Type 1 and Type 2.
3. Web role will upload image as well as feature vector into blob storage.
4. Once image is being uploaded in blob storage an entry will be made in table storage with its ID and location of generated feature vector.

3.2.2 Searching/ Verification Operation

Searching/verification operation consist comparing the images in the database with the query image given by the user for retrieval of matching images. This comparison will be done my extracting the feature vector of the user query image a comparing it with the feature vectors stored in the blob storage. Feature vectors in the blob storage compared with the query image vector and if the comparison value is higher than the pre-define threshold, then the respective image has been retrieved from the database and send as an output to the user.

The web role perform the operation of saving the user image temporarily in the blob storage and request the feature vector extraction for the given image. The worker role perform the feature vector extraction operation as well as the comparison action between the extracted feature vector and other feature vectors stored in the blob storage.

The Searching Operation consists of the following steps shown in figure (6):

1. User query image will be uploaded on web role through running web services.
2. Web role will use pre-define technique of Hybrid Wavelet Type 1 and Type 2 to compute feature vector of image using.
3. Once the image is uploaded and feature vector is calculated, web role will compare the feature vector of query image with the feature vectors stored in blob.
4. Location of the matched feature vector will be extracted and given to the web role for retrieval. Web role will go to the location in Blob storage and retrieve the matched images from the database.

The web role will give back the retrieved images onto the user screen.

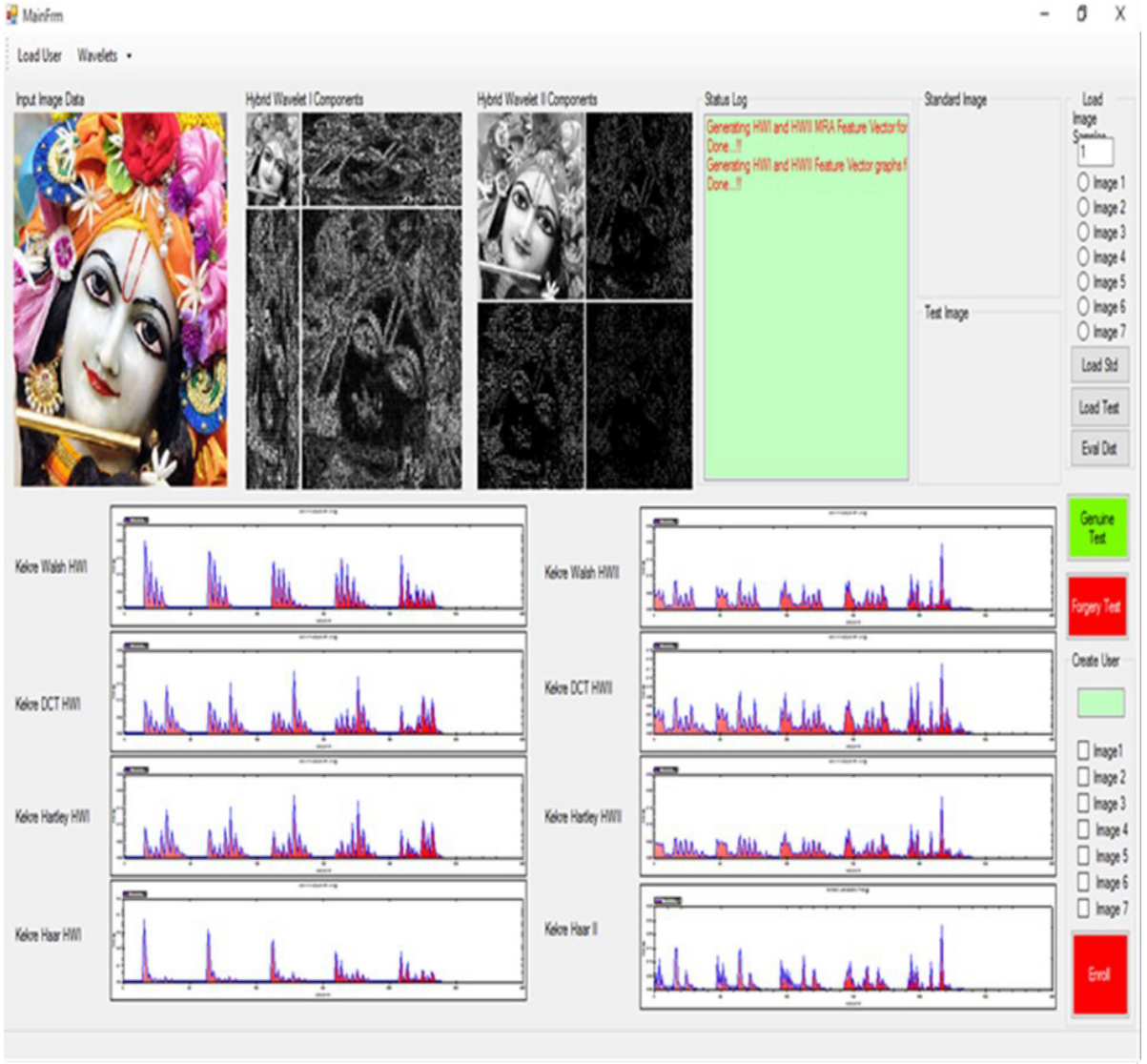


Fig 5. CBIR Implementation Model (Image Extraction, Feature Vector Computation & Image Enrollment)

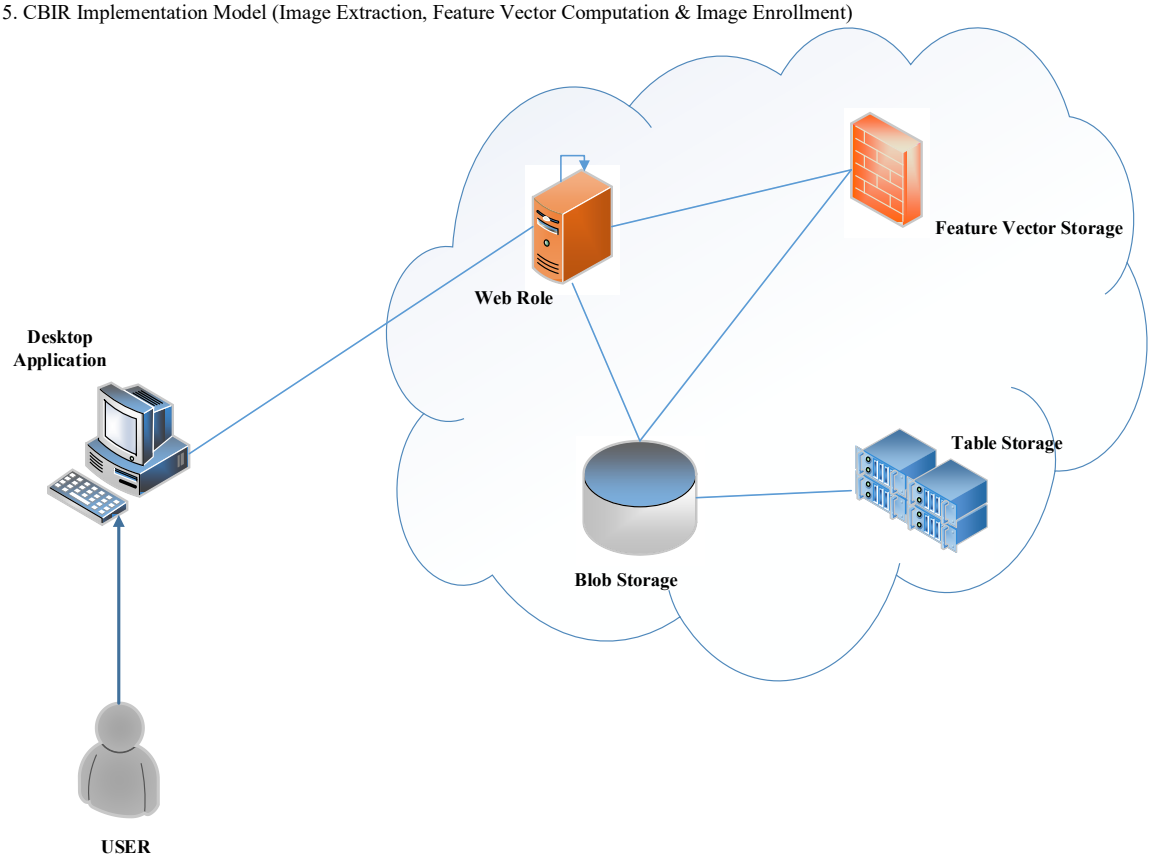


Fig6: Uploading and Searching Operation

4. Results

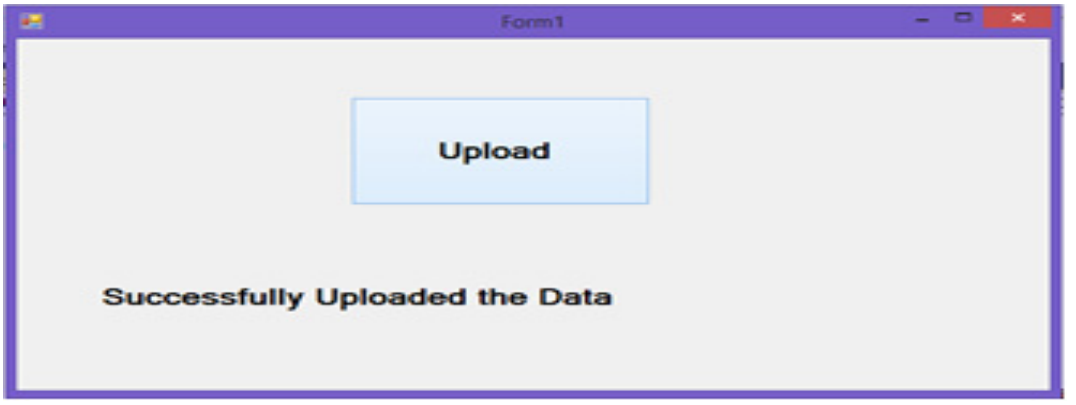
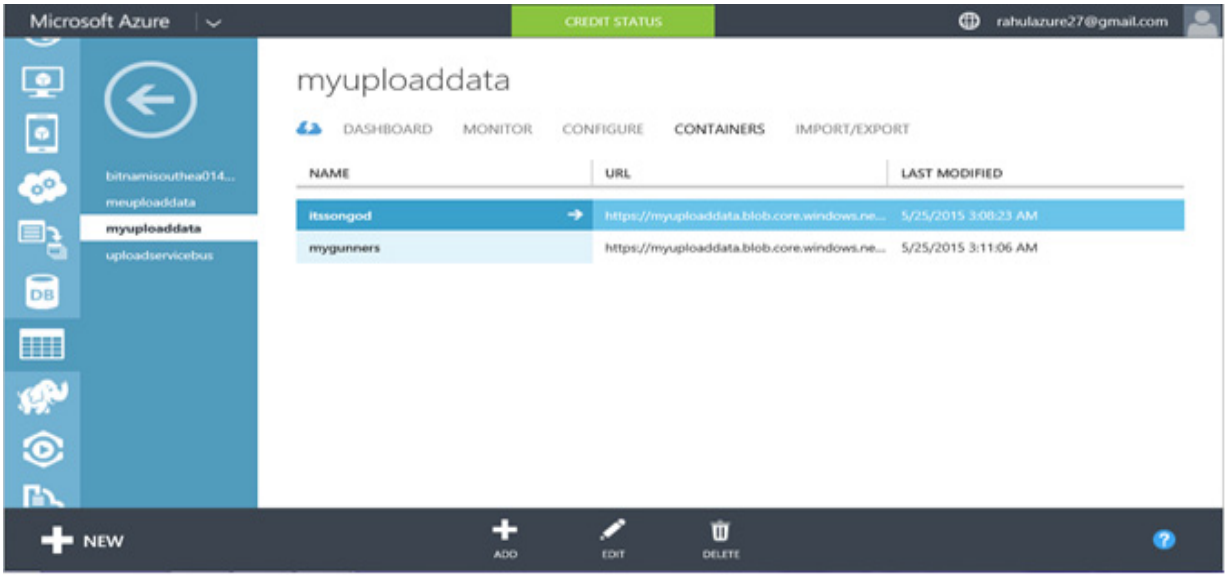


Fig 7. Uploading Image



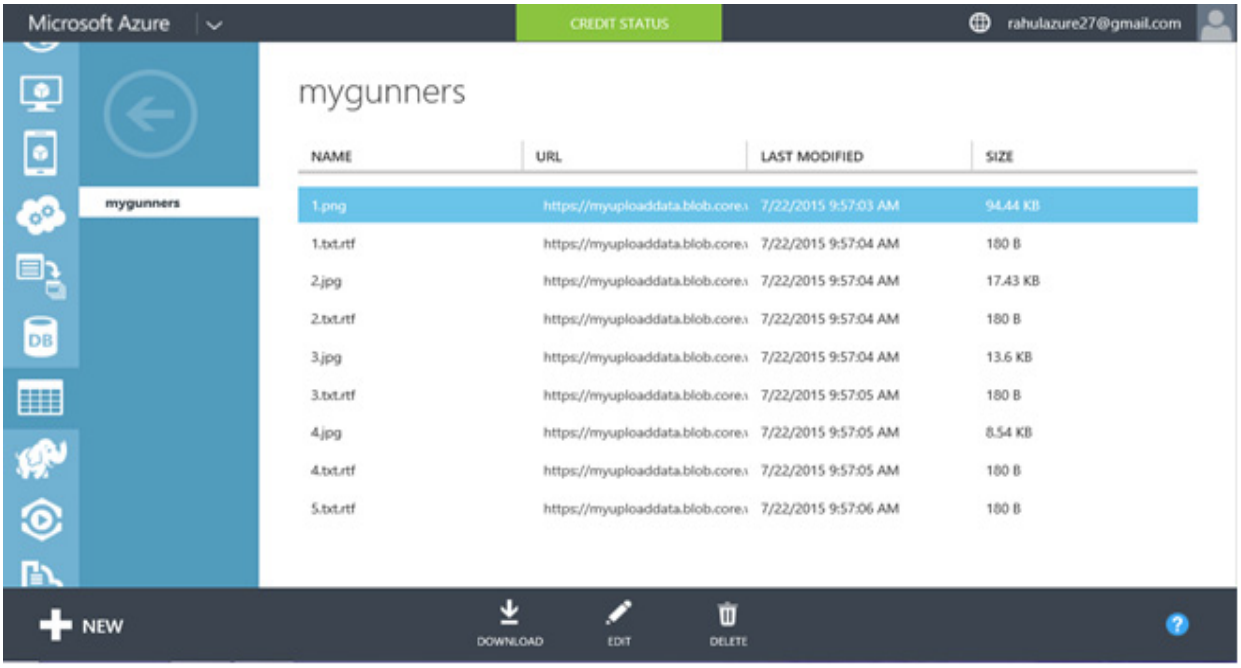


Fig 8 & 9: Uploaded Image Files on Blob Storage

The results include the images uploaded in the blob storage on the cloud. For uploading the image to the cloud, storage should be created on the cloud first. In this case, windows azure storage services are used to create cloud storage. In this paper first we implement CBIR model then Web role for Hybrid Wavelet Type 1 and Type 2 to compute feature vector of image. The image is uploaded (fig 7) and feature vector is calculated, web role will compare the feature vector of query image with the feature vectors stored in blob. Location of the matched feature vector will be extracted and given to the web role for retrieval. Web role will go to the location in Blob storage (fig 8 & 9) and retrieve the matched images from the database. The web role will give back the retrieved images onto the user screen.

5. Conclusion

This paper describes how the newly proposed architecture on cloud can resolved many issues of legacy system. Standalone system has many drawbacks, to fulfill today requirements which can be overcome using cloud. By using this we can see how the images will be uploaded, and how they will be stored in a blob storage on cloud. The public cloud based model using CBIR SaaS Architecture presented in this paper has been successfully implemented by Microsoft Azure. This system can be easily scalable, pluggable and more effective in terms of cost & efficiency. Because of its flexible on-demand principle, it can operate enormous amount of data, which in turn, gives effective use of data storage and processing power

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